WHAT IS CLAIMED IS:

1   1.   A method for managing multiple resources in a system, comprising:

2   receiving a user request for an operation that requires performing separate element

3   operations with respect to multiple resources in the system;

4   in response to the user request, communicating commands to multiple elements,

5   wherein each element is capable of managing one of the resources in the system;

6   for each element receiving at least one of the communicated commands,

7   performing:

8   (i) interpreting the received command;

9   (ii) performing the element operation requested by the received command

10   with respect to the managed resource, wherein all the element operations

11   performed by all the elements in response to receiving the commands implement

12   the user requested operation.

1   2.   The method of claim 1, wherein the user requested operation comprises a

2   request to allocate at least one resource in the system to a host in the system, and wherein

3   the element operations requested by the received command comprise configuration

4   operations to configure the managed resources to implement the user requested resource

5   allocation.

1   3.   The method of claim 2, wherein the request to allocate the at least one

2   system resource comprises a request to allocate additional storage space in the system to

3   the host.

1   4.   The method of claim 3, wherein the request to allocate the at least one

2   system resource includes a request to allocate the storage space to a logical volume in the

3   host, wherein the resources managed by the elements comprise a storage device, a switch,

4   a host adaptor, file system, and a volume manager, wherein the element managing the

5   storage device allocates the storage space to the host, wherein the element managing the

6   switch is capable of allocating at least one path in the switch to the storage device to

7   allow the host to access the allocated storage space, wherein the element managing the

8   host adaptors allocates at least one host adaptor in the host to communicate with the

9   switch to access the allocated storage space, and wherein the element managing the

10   volume manager assigns the allocated storage space in the device to the requested logical

11   volume used by the host.

1   5.   The method of claim 4, wherein the system is capable of including

2   multiple storage devices, switches, and host adaptors in the host, and wherein there is at

3   least one separate element to manage each storage device and switch in the system.

1   6.   The method of claim 5, further comprising:

2   in response to the communicated commands, determining, with the elements, at

3   least one switch and storage device in the system capable of supplying the storage and

4   path resources to satisfy the user request, wherein the commands are communicated to the

5   elements managing the determined switches and storage devices.

1   7.   The method of claim 1, wherein each resource in the system is capable of

2   being managed by multiple elements, wherein each of multiple elements for one resource

3   performs the element operation in a different manner than other elements.

1   8.   The method of claim 7, wherein there is an application program interface

2   (API) set for each resource in the system, wherein the multiple element objects capable of

3   managing one resource call the same API set to perform operations with respect to the

4   managed resource.

1   9.   The method of claim 1, wherein the commands are communicated by

2   using element proxy objects registered with a lookup service.

1   10.   A method for managing multiple resources in a system, comprising:

2   registering a configuration service proxy object with a lookup service, wherein the

3   configuration service proxy object includes code enabling access to a configuration

4   service capable of configuring resources in the system;

5   registering configuration element proxy objects with the lookup service, wherein

6   the configuration element proxy objects include code enabling access to element

7   configurations that are capable of configuring system resources;

8   using the code in the configuration proxy object to communicate a user request for

9   a configuration operation with respect to at least one system resource to the configuration

10   service; and

11   using, with the configuration service, the code in the configuration element proxy

12   objects to communicate commands to the configuration elements to implement the

13   requested configuration operations; and

14   in response to receiving the commands from the configuration service,

15   performing, with the configuration elements, a configuration operation on the resource

16   indicated in the received commands.

1   11.   The method of claim 10, wherein all the configuration operations

2   performed by all the configuration elements in response to receiving commands from the

3   configuration service implement the user requested configuration operation.

1   12.   The method of claim 10, wherein the user requested configuration

2   operation comprises a request to allocate a resource in the system to a host in the system,

3   and wherein the configuration operations performed by the configuration elements

4   receiving the commands from the configuration service implement the user requested

5   resource allocation.

1   13.   The method of claim 12, wherein the user requested resource allocation

2   comprises a request to allocate more storage space in the system to the host.

1   14.   The method of claim 10, wherein the request to allocate the system

2   resource includes a request to allocate the storage space to a logical volume in the host,

3   wherein the resources managed by the configuration elements comprise a storage device,

4   a switch, a host adaptor, and a volume manager, wherein the configuration element

5   managing the storage device allocates the storage space to the host, wherein the

6   configuration element managing the switch is capable of allocating one or more paths in

7   the switch to the storage device to allow the host to access the allocated storage space,

8   wherein the configuration element managing the host adaptors is capable of allocating

9   one or more host adaptors to access the allocated storage space through the switch, and

10   wherein the configuration element managing the volume manager assigns the allocated

11   storage space to the requested logical volume.

1   15.   The method of claim 10, wherein the system is capable of including

2   multiple storage devices, switches, and host adaptors in the host, and wherein there is at

3   least one separate configuration element to manage each storage device and switch in the

4   system.

1   16   The method of claim 15, further comprising:

2   in response to the user request, determining, with the configuration elements, at

3   least one switch, storage device, and host adaptor in the system capable of supplying the

4   storage and path resources to satisfy the user request, wherein the configuration elements

5   configure the determined switches and storage devices.

1   17.   The method of claim 16, wherein the configuration elements query

2   information on the system components to determine the system components capable of

3   satisfying the user requested configuration operation.

1   18.   The method of claim 16, wherein configuration policy parameters are

2   provided with each configuration element that specify how each configuration element

3   configure the associated switch, storage device, or host adaptor.

1   19.   The method of claim 18, wherein the configuration policy parameters

2   specify a level of availability to provide with the allocated storage space.

1   20.   The method of claim 14, wherein there are multiple configuration services

2   calling different sets of elements to provide different qualitiess of configurations, further

3   comprising:

4   selecting one of the configuration services.

1   21.   The method of claim 14, wherein the system is further capable of

2   including backup programs and snapshot image programs, wherein there is at least one

3   configuration element to manage each backup program and snapshot image program in

4   each host.

1   22.   The method of claim 10, wherein each resource in the system is capable of

2   having multiple elements, wherein each of the multiple elements provided to configure

3   one resource configure the resource differently.

1   23.   The method of claim 22, wherein there is an application program interface

2   (API) proxy object for each resource in the system, wherein the multiple elements capable

3   of configuring one resource use the same API proxy object to configure the associated

4   resource.

1   24.   The method of claim 10, wherein the configuration service proxy object

2   enables either remote or local access to the configuration service to configure capable of

3   configuring resources in the system

1   25.   A method for managing multiple resources in a system, comprising:

2   invoking a management program;

3   providing the management program a set of user specified operational parameters

4   to use for a system operation performed with respect to the system resources;

5   calling, with the management program multiple elements, wherein each element is

6   capable of managing one of the resources in the system by performing an element

7   operation;

8   for each element called by the management program, performing:

9   (i) interpreting the received command;

10   (ii) performing the element operation requested by the received command

11   with respect to the managed resource, wherein the elements control the managed

12   resource according to predefined element operational parameters and the user

13   specified operational parameters.

1   26.   The method of claim 25, wherein the user specified operational parameters

2   comprise a request to allocate at least one resource in the system to a host in the system,

3   wherein the element operations comprise configuration operations to configure the

4   managed resources to implement the user specified resource allocation.

1   27.   The method of claim 26, wherein the request to allocate the at least one

2   system resource comprises a request to allocate additional storage space in the system to

3   the host.

1   28.   The method of claim 27, wherein the request to allocate the at least one

2   system resource includes a request to allocate the storage space to a logical volume in the

3   host, wherein the resources managed by the elements comprise a storage device, a switch,

4   a host adaptor, file system, and a volume manager, wherein the element managing the

5   storage device allocates the storage space to the host, wherein the element managing the

6   switch is capable of allocating at least one path in the switch to the storage device to

7   allow the host to access the allocated storage space, wherein the element managing the

8   host adaptors allocates at least one host adaptor in the host to communicate with the

9   switch to access the allocated storage space, and wherein the element managing the

10   volume manager assigns the allocated storage space in the device to the requested logical

11   volume used by the host.

1   29.   The method of claim 28, wherein the system is capable of including

2   multiple storage devices, switches, and host adaptors in the host, and wherein there is at

3   least one separate element to manage each storage device and switch in the system.

1   30.   The method of claim 25, wherein each resource in the system is capable of

2   being managed by multiple elements, wherein each of multiple elements for one resource

3   performs the operation in a different manner than other elements.

1   31.   The method of claim 30, wherein there are multiple management

2   programs, wherein each management program calls one of the multiple elements for each

3   resource to control, and wherein different management programs call different elements

4   for at least one resource to perform different operations with respect to the resource.

1   32.   A system for managing multiple resources, comprising:

2   multiple resources;

3   means for receiving a user request for an operation that requires performing

4 separate element operations with respect to the multiple resources in the system;

5   means for communicating, in response to the user request, commands to multiple

6 elements, wherein each element is capable of managing one of the resources in the

7 system;

8   multiple element means for performing, in response to receiving at least one of the

9 communicated commands, interpreting the received command and performing the

10 element operation requested by the received command with respect to the managed

11 resource, wherein all the element operations performed by all the elements in response to

12 receiving the commands implement the user requested operation.

1   33.   The system of claim 32, wherein the user requested operation comprises a

2 request to allocate at least one resource in the system to a host in the system, and wherein

3 the element operations requested by the received command comprise configuration

4 operations to configure the managed resources to implement the user requested resource

5 allocation.

1   34.   The system of claim 33, wherein the request to allocate the at least one

2 system resource comprises a request to allocate additional storage space in the system to

3 the host.

1   35.   The system of claim 34, wherein the request to allocate the at least one

2 system resource includes a request to allocate the storage space to a logical volume in the

3 host, wherein the resources managed by the elements comprise a storage device, a switch,

4 a host adaptor, file system, and a volume manager, wherein the element managing the

5 storage device allocates the storage space to the host, wherein the element managing the

6   switch is capable of allocating at least one path in the switch to the storage device to

7   allow the host to access the allocated storage space, wherein the element managing the

8   host adaptors allocates at least one host adaptor in the host to communicate with the

9   switch to access the allocated storage space, and wherein the element managing the

10 volume manager assigns the allocated storage space in the device to the requested logical

11 volume used by the host.

1   36.   The system of claim 35, wherein the system is capable of including

2   multiple storage devices, switches, and host adaptors in the host, and wherein there is at

3   least one separate element means to manage each storage device and switch in the system.

1   37.   The system of claim 36, wherein the multiple element means further

2   perform:

3   determining at least one switch and storage device in the system capable of

4   supplying the storage and path resources to satisfy the user request, wherein the

5   commands are communicated to the elements managing the determined switches and

6   storage devices.

1   38.   The system of claim 32, wherein each resource in the system is capable of

2   being managed by multiple element means, wherein each of multiple element means for

3   one resource performs the element operation in a different manner than other elements.

1   39.   The system of claim 38, wherein there is an application program interface

2   (API) set for each resource in the system, wherein the multiple element objects capable of

3   managing one resource call the same API set to perform operations with respect to the

4   managed resource.

1   40.   The system of claim 32, wherein the commands are communicated by

2 using element proxy objects registered with a lookup service.

1   41.   An article of manufacture including code for managing multiple resources

2 in a system by:

3   receiving a user request for an operation that requires performing separate element

4 operations with respect to multiple resources in the system;

5   in response to the user request, communicating commands to multiple elements,

6 wherein each element is capable of managing one of the resources in the system;

7   for each element receiving at least one of the communicated commands,

8 performing:

9   (i) interpreting the received command;

10   (ii) performing the element operation requested by the received command

11   with respect to the managed resource, wherein all the element operations

12   performed by all the elements in response to receiving the commands implement

13   the user requested operation.

1   42.   The article of manufacture of claim 41, wherein the user requested

2 operation comprises a request to allocate at least one resource in the system to a host in

3 the system, and wherein the element operations requested by the received command

4 comprise configuration operations to configure the managed resources to implement the

5 user requested resource allocation.

1   43.   The article of manufacture of claim 42, wherein the request to allocate the

2 at least one system resource comprises a request to allocate additional storage space in the

3 system to the host.

1   44.   The article of manufacture of claim 43, wherein the request to allocate the

2   at least one system resource includes a request to allocate the storage space to a logical

3   volume in the host, wherein the resources managed by the elements comprise a storage

4   device, a switch, a host adaptor, file system, and a volume manager, wherein the element

5   managing the storage device allocates the storage space to the host, wherein the element

6   managing the switch is capable of allocating at least one path in the switch to the storage

7   device to allow the host to access the allocated storage space, wherein the element

8   managing the host adaptors allocates at least one host adaptor in the host to communicate

9   with the switch to access the allocated storage space, and wherein the element managing

10   the volume manager assigns the allocated storage space in the device to the requested

11   logical volume used by the host.

1   45.   The article of manufacture of claim 44, wherein the system is capable of

2   including multiple storage devices, switches, and host adaptors in the host, and wherein

3   there is at least one separate element to manage each storage device and switch in the

4   system.

1   46.   The article of manufacture of claim 45, further comprising:

2   in response to the communicated commands, determining, with the elements, at

3   least one switch and storage device in the system capable of supplying the storage and

4   path resources to satisfy the user request, wherein the commands are communicated to the

5   elements managing the determined switches and storage devices.

1   47.   The article of manufacture of claim 41, wherein each resource in the

2   system is capable of being managed by multiple elements, wherein each of multiple

3   elements for one resource performs the element operation in a different manner than other

4   elements.

1   48.   The article of manufacture of claim 41, wherein there is an application

2 program interface (API) set for each resource in the system, wherein the multiple element

3 objects capable of managing one resource call the same API set to perform operations

4 with respect to the managed resource.

1   49.   The article of manufacture of claim 41, wherein the commands are

2 communicated by using element proxy objects registered with a lookup service.

1   50.   An article of manufacture including code for managing multiple resources

2 in a system by:

3   registering a configuration service proxy object with a lookup service, wherein the

4 configuration service proxy object includes code enabling access to a configuration

5 service capable of configuring resources in the system;

6   registering configuration element proxy objects with the lookup service, wherein

7 the configuration element proxy objects include code enabling access to element

8 configurations that are capable of configuring system resources;

9   using the code in the configuration proxy object to communicate a user request for

10 a configuration operation with respect to at least one system resource to the configuration

11 service;

12   using, with the configuration service, the code in the configuration element proxy

13 objects to communicate commands to the configuration elements to implement the

14 requested configuration operations; and

15   in response to receiving the commands from the configuration service,

16 performing, with the configuration elements, a configuration operation on the resource

17 indicated in the received commands.

1   51.   The article of manufacture of claim 50, wherein all the configuration

2 operations performed by all the configuration elements in response to receiving

3   commands from the configuration service implement the user requested configuration

4   operation.

1   52.   The article of manufacture of claim 50, wherein the user requested

2   configuration operation comprises a request to allocate a resource in the system to a host

3   in the system, and wherein the configuration operations performed by the configuration

4   elements receiving the commands from the configuration service implement the user

5   requested resource allocation.

1   53.   The article of manufacture of claim 52, wherein the user requested

2   resource allocation comprises a request to allocate additional storage space in the system

3   to the host.

1   54.   The article of manufacture of claim 50, wherein the request to allocate the

2   at least one system resource includes a request to allocate the storage space to a logical

3   volume in the host, wherein the resources managed by the configuration elements

4   comprise a storage device, a switch, a host adaptor, file system, and a volume manager,

5   wherein the configuration element managing the storage device allocates the storage

6   space to the host, wherein the configuration element managing the switch is capable of

7   allocating one or more paths in the switch to the storage device to allow the host to access

8   the allocated storage space, wherein the configuration element managing the host

9   adaptors is capable of allocating one or more host adaptors to access the allocated storage

10   space through the switch, and wherein the configuration element managing the volume

11   manager assigns the allocated storage space to the requested logical volume.

1   55.   The article of manufacture of claim 50, wherein the system is capable of

2   including multiple storage devices, switches, and host adaptors in the host, and wherein

3   there is at least one separate configuration element to manage each storage device and

4   switch in the system.

1   56   The article of manufacture of claim 55, further comprising:

2   in response to the user request, determining, with the configuration elements, at

3   least one switch, storage device, and host adaptor in the system capable of supplying the

4   storage and path resources to satisfy the user request, wherein the configuration elements

5   configure the determined switches and storage devices.

1   57.   The article of manufacture of claim 56, wherein the configuration elements

2   query information on the system components to determine the system components

3   capable of satisfying the user requested configuration operation.

1   58.   The article of manufacture of claim 56, wherein configuration policy

2   parameters are provided with each configuration element that specify how each

3   configuration element configure the associated switch, storage device, or host adaptor.

1   59.   The article of manufacture of claim 58, wherein the configuration policy

2   parameters specify a level of availability to provide with the allocated storage space.

1   60.   The article of manufacture of claim 54, wherein there are multiple

2   configuration services calling different sets of elements to provide different qualities of

3   configurations, further comprising:

4   selecting one of the configuration services.

1   61.   The article of manufacture of claim 54, wherein the system is further

2   capable of including backup programs and snapshot image programs, wherein there is at

3   least one configuration element to manage each backup program and snapshot image

4   program in each host.

1   62.   The article of manufacture of claim 50, wherein each resource in the

2   system is capable of being managed by multiple elements, wherein each of the multiple

3   elements provided to configure one resource configure the resource differently.

1   63.   The article of manufacture of claim 62, wherein there is an application

2   program interface (API) proxy object for each resource in the system, wherein the

3   multiple elements capable of configuring one resource use the same API proxy object to

4   configure the associated resource.

1   64.   The article of manufacture of claim 50, wherein the configuration service

2   proxy object enables either remote or local access to the configuration service to

3   configure capable of configuring resources in the system

1   65.   A computer readable medium including data structures for managing

2   multiple resources in a system, comprising:

3   a manager object including multiple commands that together implement a system

4   operation with respect to multiple resources in the system; and

5   multiple element objects, wherein each element object is capable of managing one

6   of the resources in the system, wherein the manager object communicates commands to

7   multiple elements, wherein each element receiving at least one of the communicated

8   commands interprets the received command and performs an element operation requested

9   by the received command with respect to the managed resource, wherein all the element

10   operations performed by all the elements in response to receiving the commands

11   implement the requested system operation.

1   66.   The computer readable medium of claim 65, wherein the system operation

2   comprises a request to allocate at least one resource in the system to a host in the system,

3   and wherein the element operations requested by the received command comprise

4   configuration operations to configure the managed resources to implement the user

5   requested resource allocation.

1   67.   The computer readable medium of claim 65, wherein each resource in the

2   system is capable of being managed by multiple elements, wherein each of the multiple

3   elements that manage one resource performs the element operation in a different manner

4   than other elements.

1   68.   The computer readable medium of claim 67, wherein there is an

2   application program interface (API) set for each resource in the system, wherein the

3   multiple element objects capable of managing one resource call the same API set to

4   perform operations with respect to the managed resource.

1   69.   The computer readable medium of claim 65, wherein the manager object

2   and element objects comprise proxy objects, further comprising:

3   a lookup service including registered instances of the manager proxy objects and

4   element proxy objects, wherein the manager and element proxy objects include code

5   enabling access to the operations performed by the proxy objects.